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Measurement Science & Standards in Forensic Firearms Analysis

Measurement Science Advances in Firearms Analysis

Focus Variation

Brad Etter
Alicona

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004606032012

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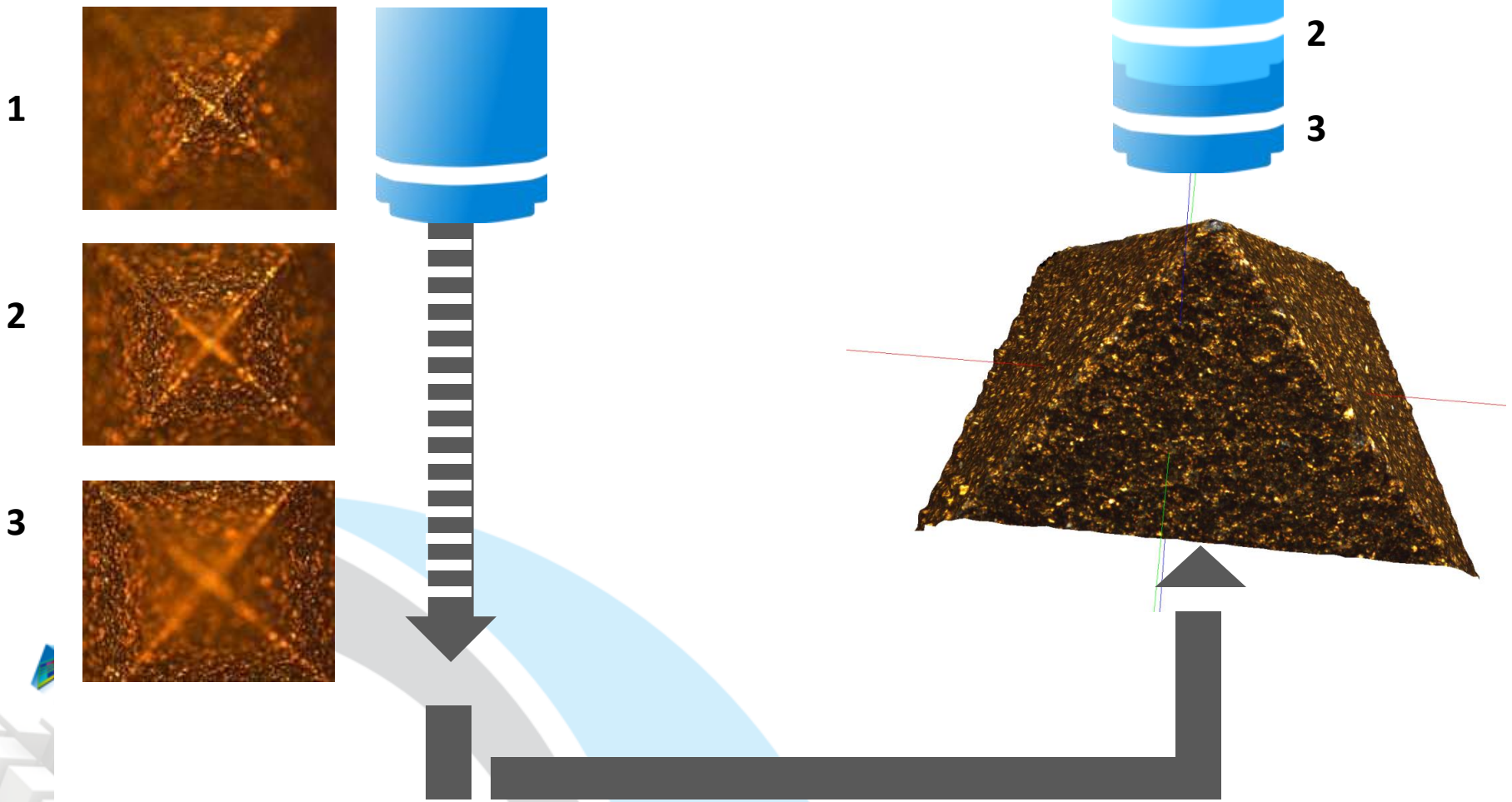
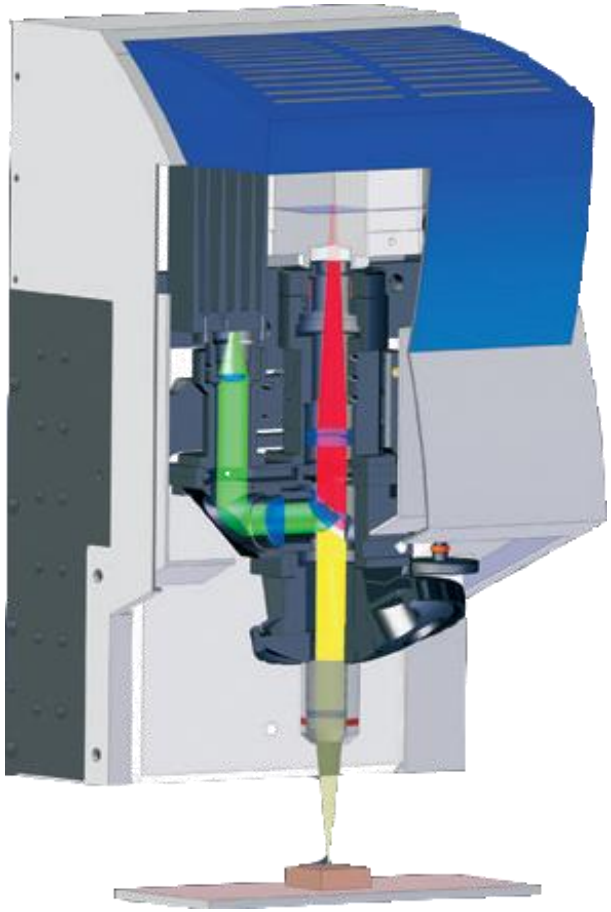
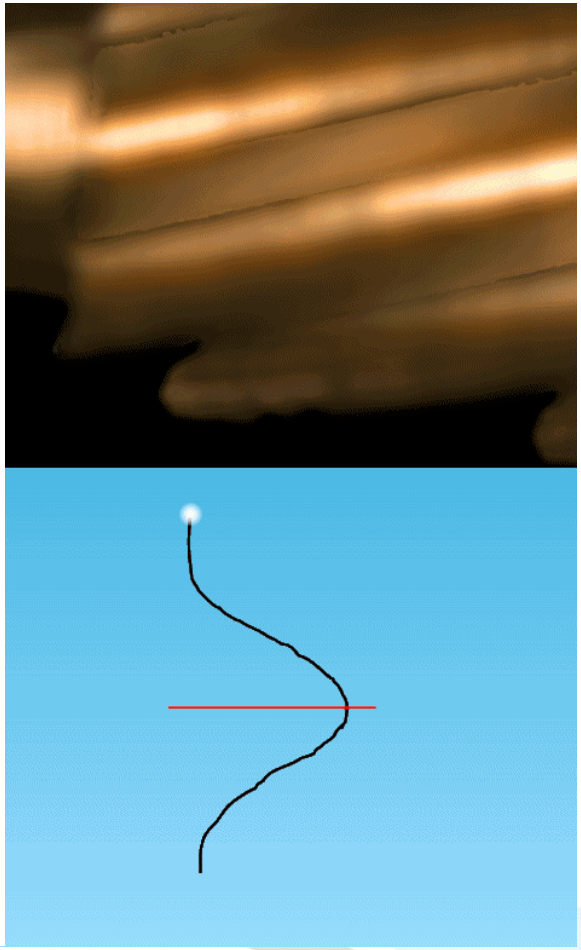
Focus-Variation



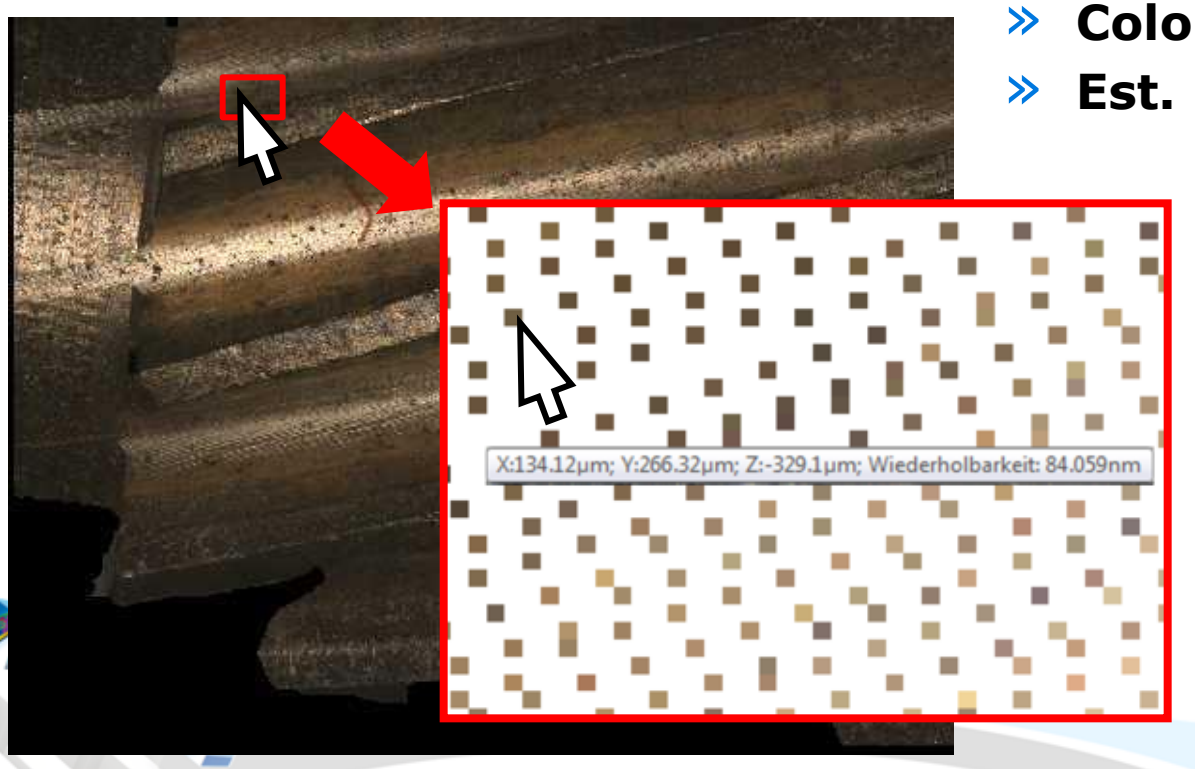
Focus-Variation as a Measurement Technique





Information at each Measurement Point

- 3D-Position (x, y, z)
- Color (R G B)
- Est. Repeatability



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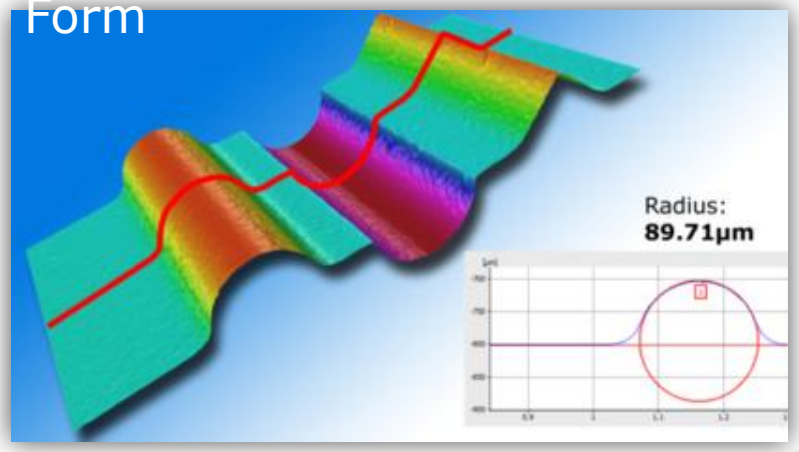
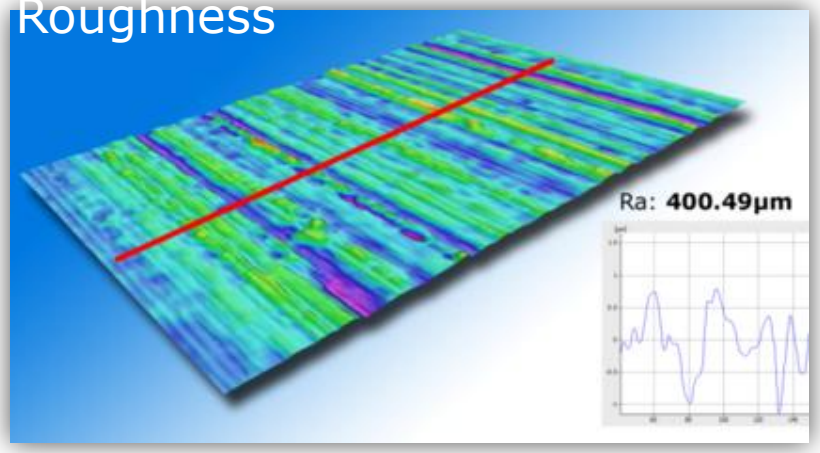
Measure Form and Roughness with one Instrument

Form



&

Roughness



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Benefits of Focus-Variation

+ Form and roughness in one measurement

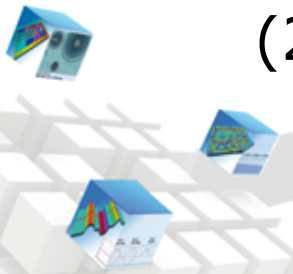
+ Rough and smooth surfaces
+ Color information
+ Steep flanks
+ Diversity of materials
+ Large measurement areas
+ Ease of use

Focus-Variation Technical Specifications

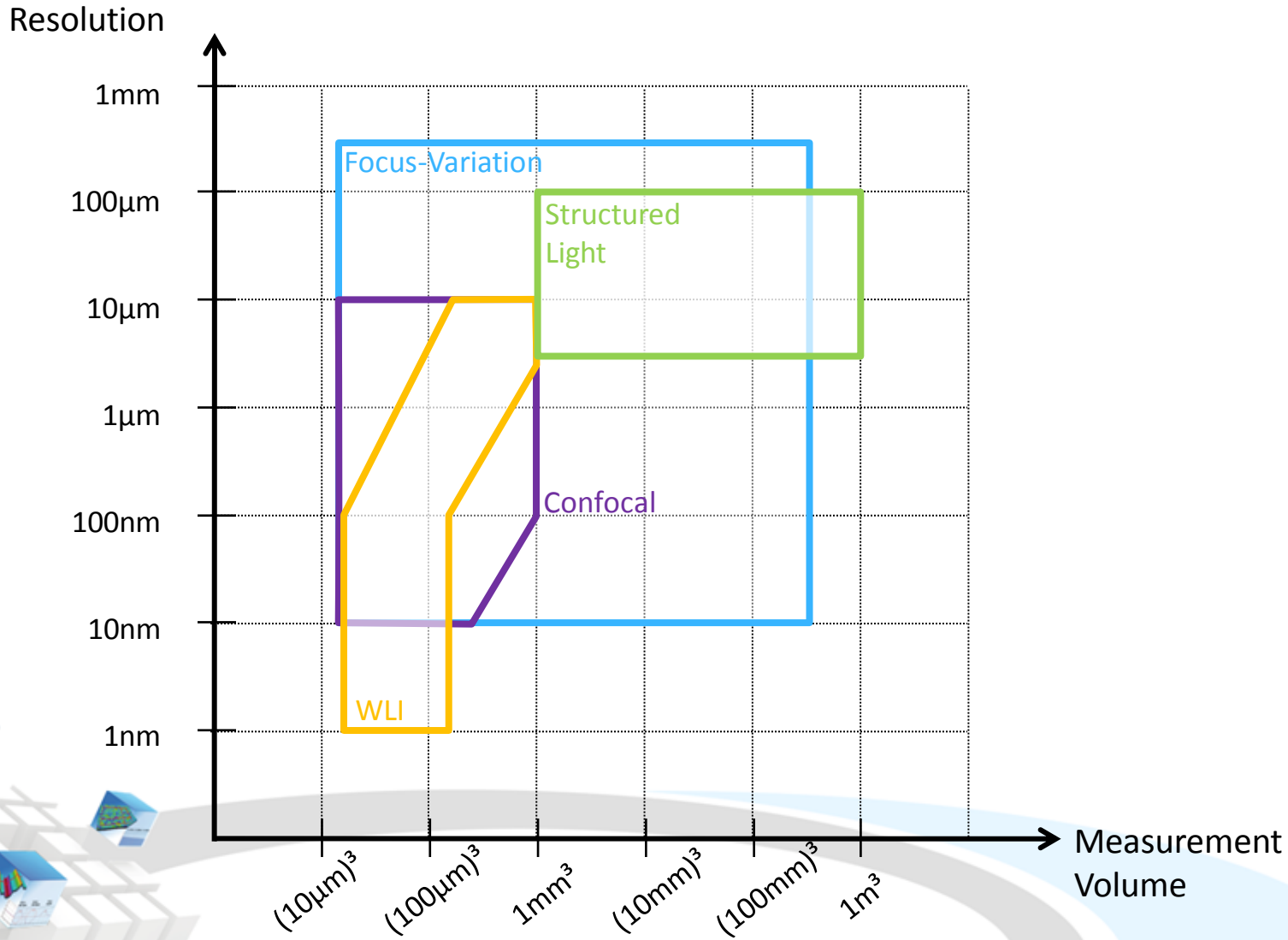
Optical 3D-surface metrology
based on a color focus sensor

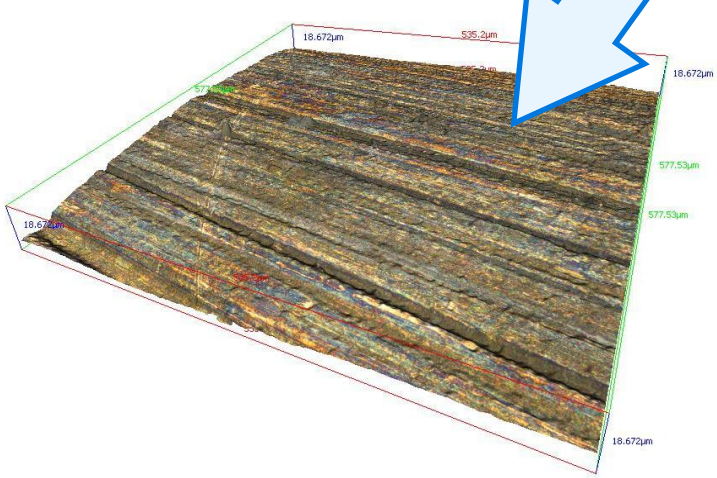
Vertical resolution	**>10nm**
Lateral resolution	**>400nm**
Scan height	**<22mm**
Scan area	**100mm x 100mm**

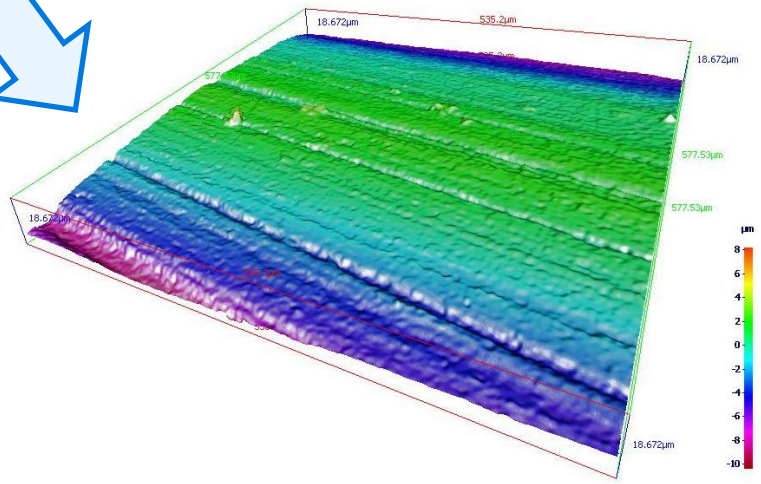
Surface measurements in less than 16 sec.
(2 million measurement points)



Where Focus Variation Fits







- 50X Objective
- Vertical Resolution: 20nm

Number of Points: 10million

Size of ImageField: 2.66mm x 1.80mm

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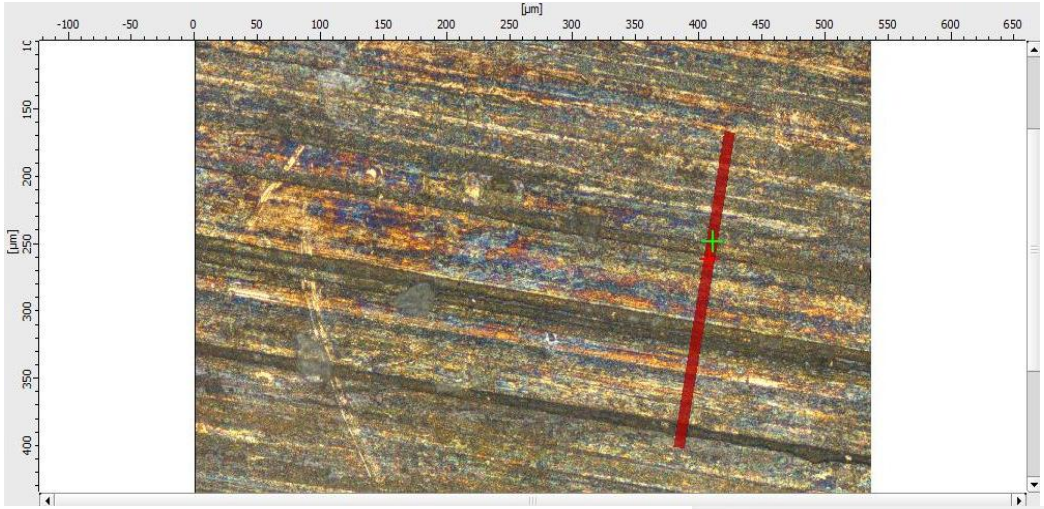
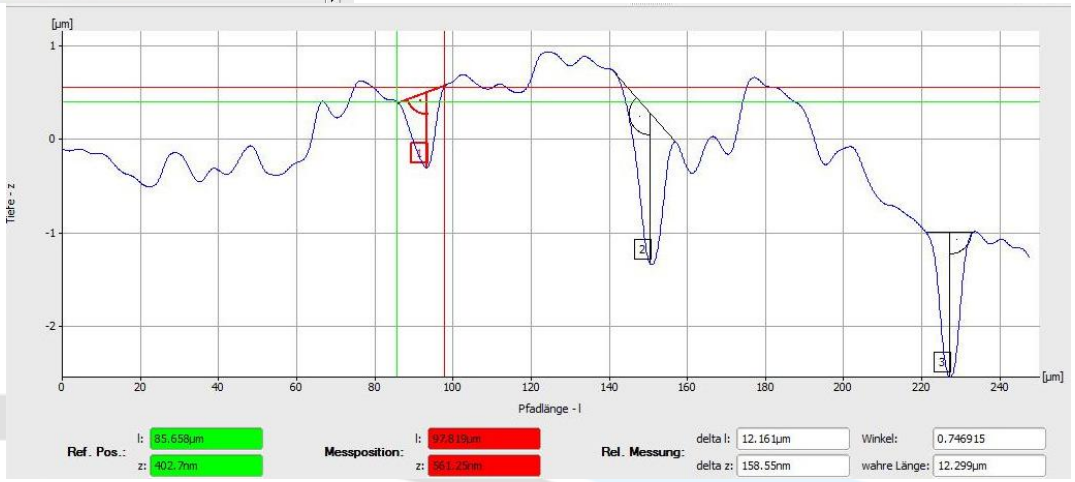
Profile Form Measurement



- Profile path: 50x objective, realcolor.
  - Profile width 8.8µm

Measurement	Depth	Width
[1] Rifling	0.8µm	12.2µm
[2] Rifling	1.6µm	15.3µm
[3] Rifling	1.5µm	12.4µm



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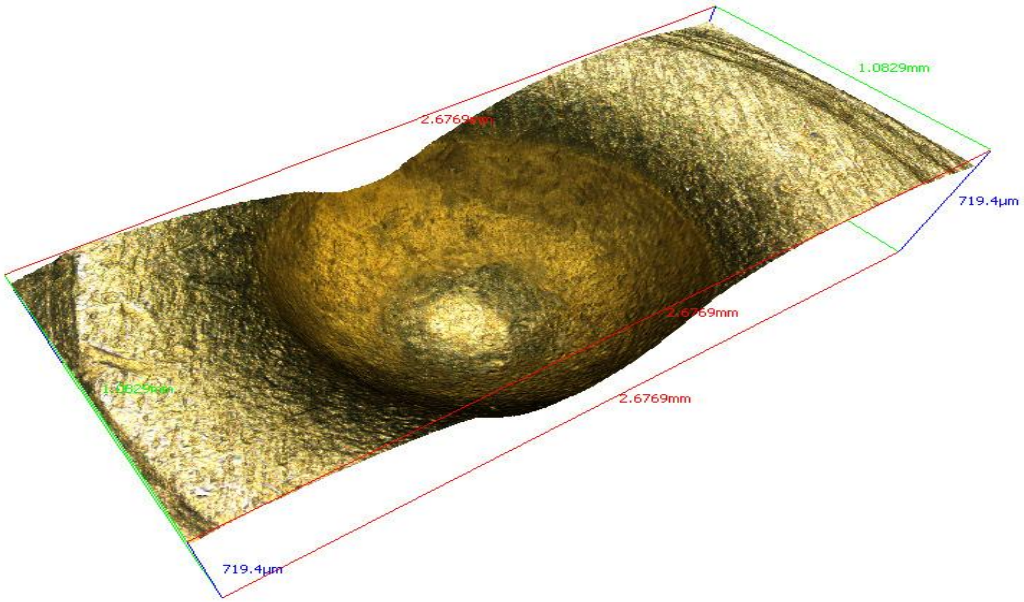
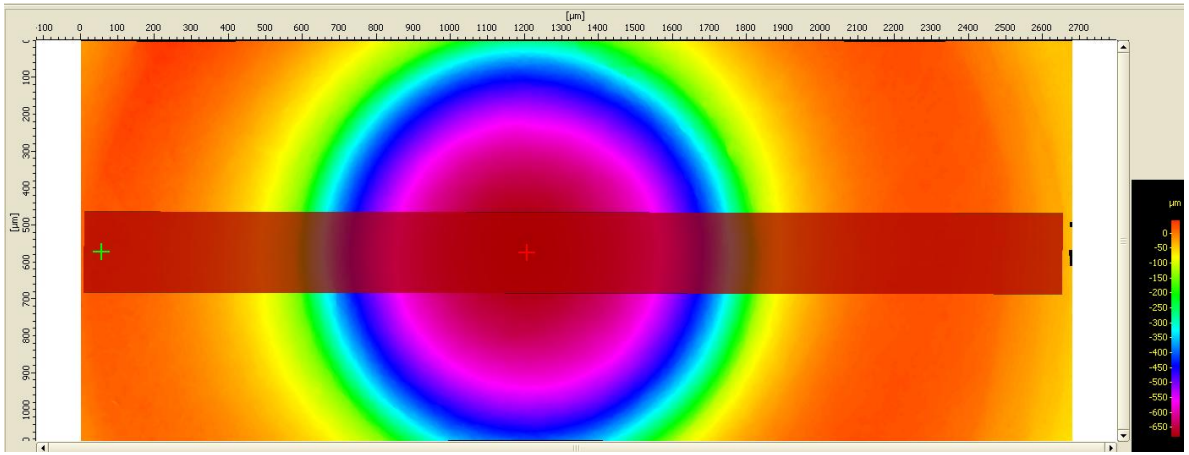
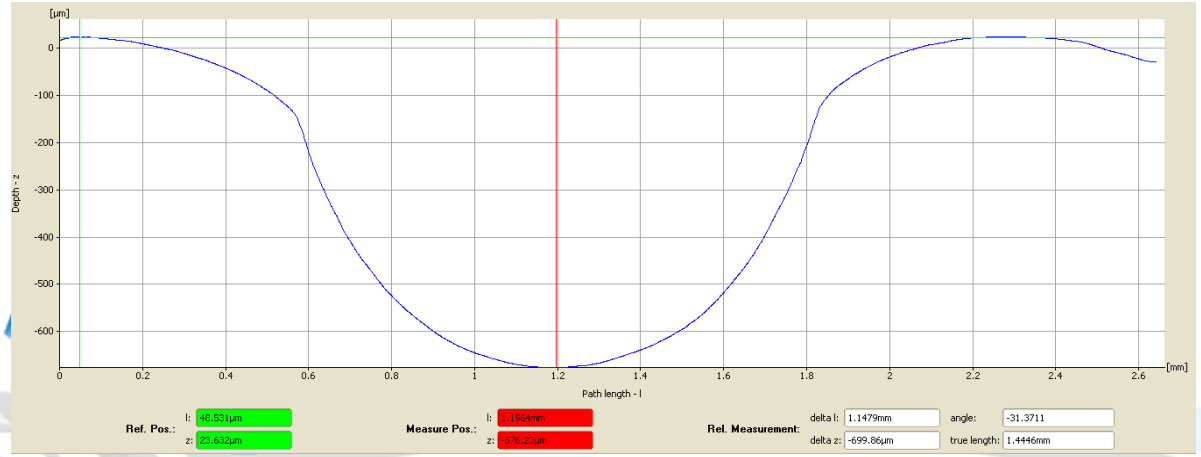
Firing Pin



- Objective 10x Size of measurement point 880nm
- Vertical resolution 800nm
- Number of points 3.7 million
- Size of ImageField 2.68mm x 1.08mm

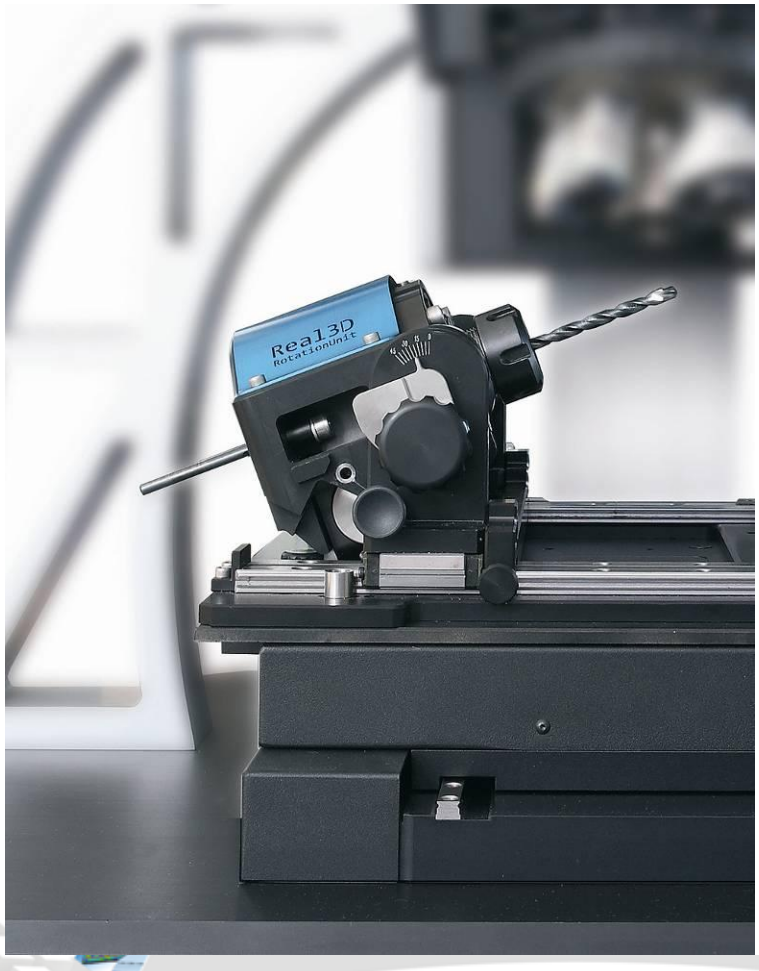
Firing Pin

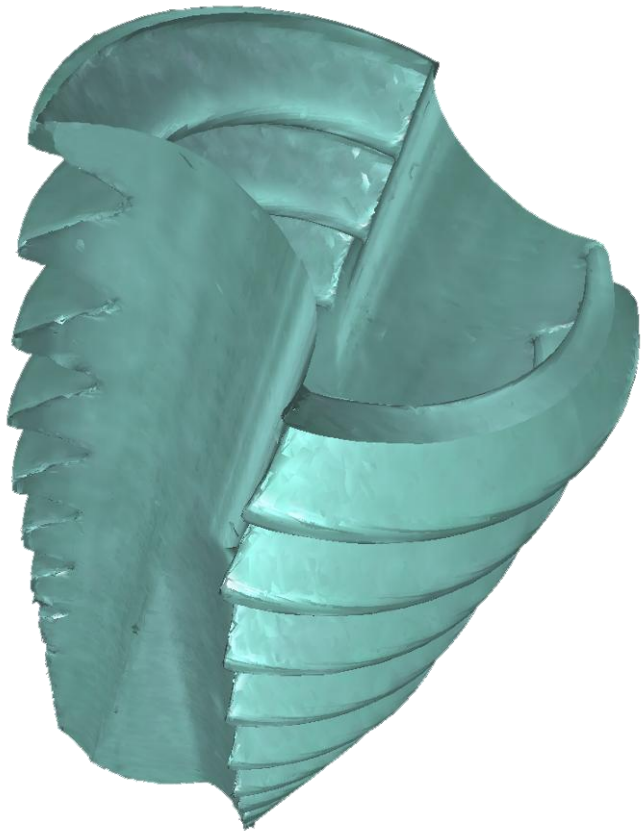




» Depth 699.9µm

Real3D





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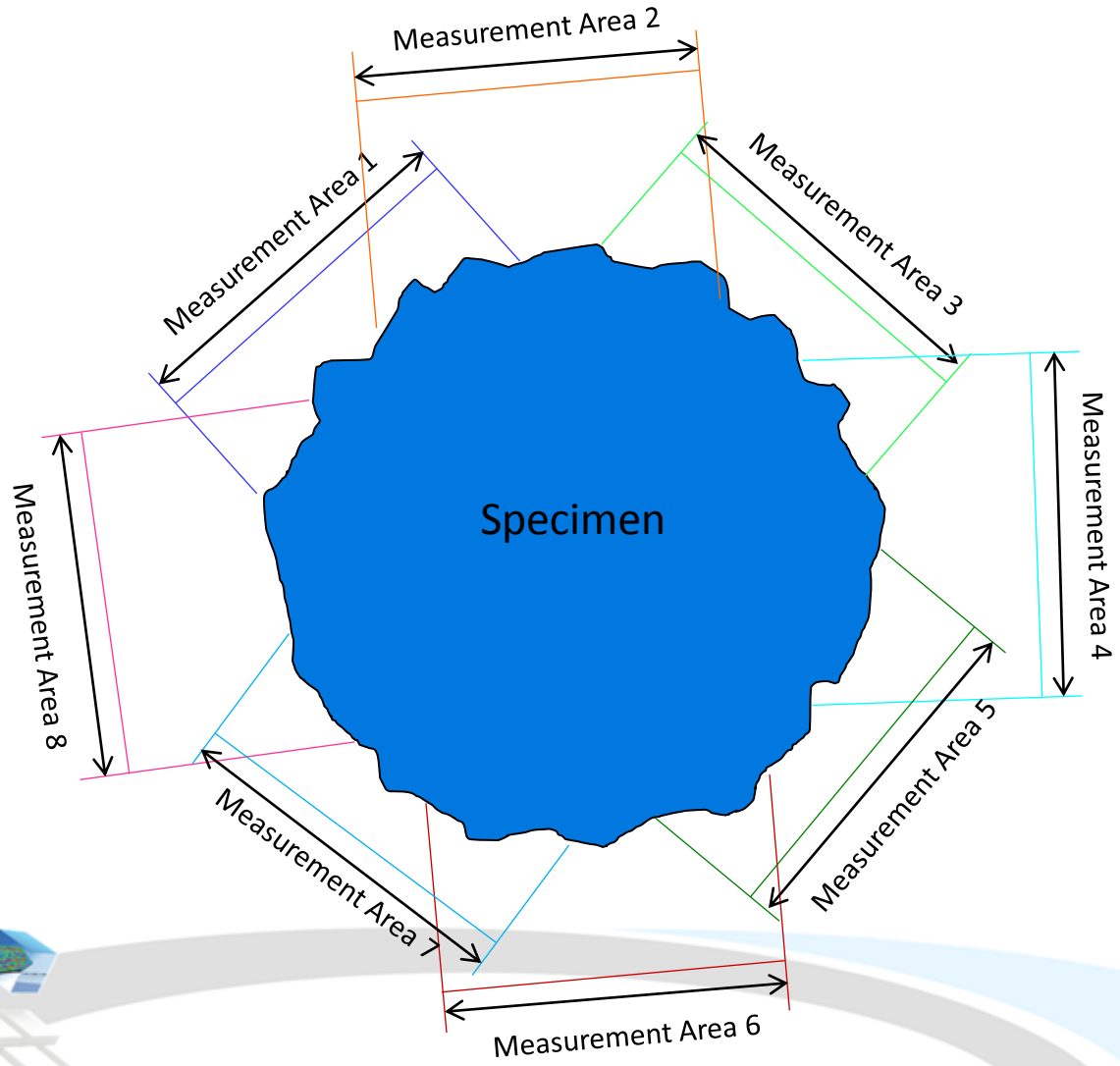
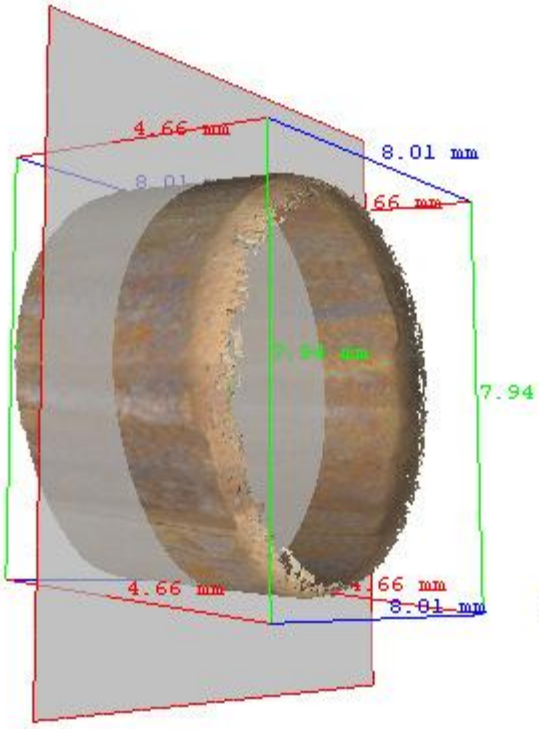
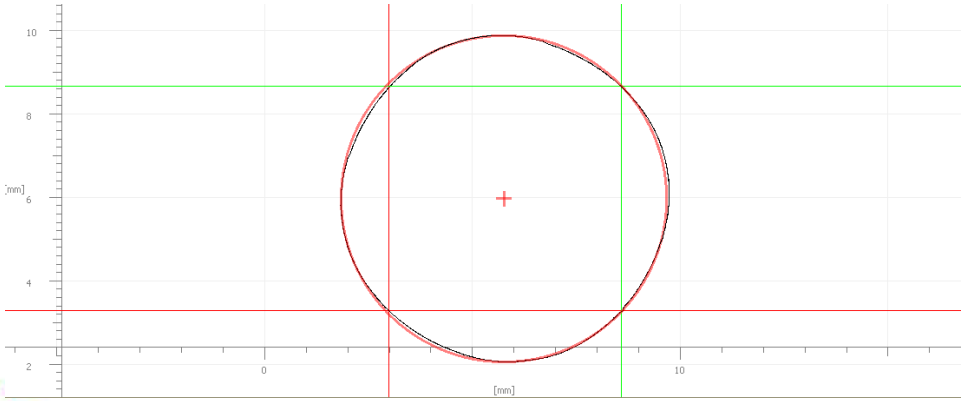
Measuring Real3D-Data



Contour Analysis





- Measurement results contour analysis – Circle fitting
  - Radius 3.919 mm
  - Surface 48.25 mm²
  - Maximum deviation 82.17 µm
  - Mean deviation 35.797 µm

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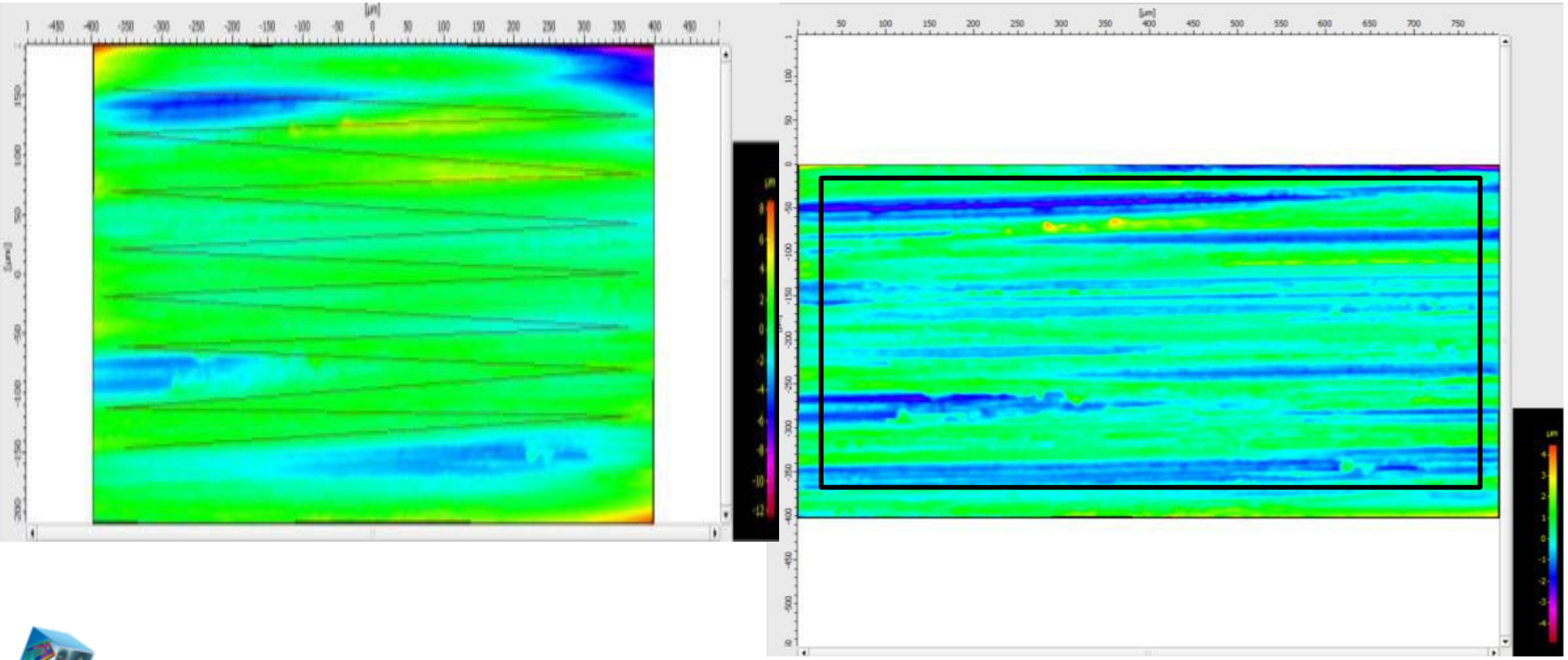
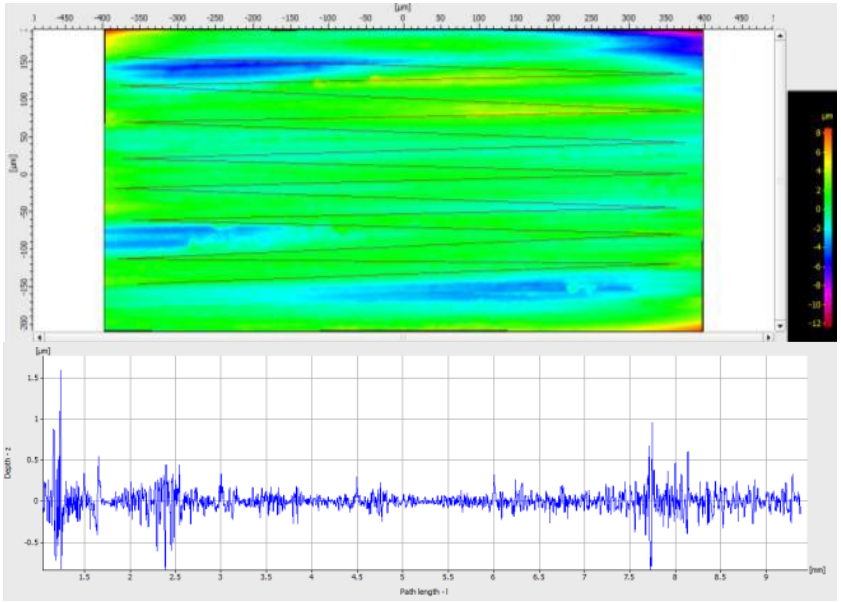
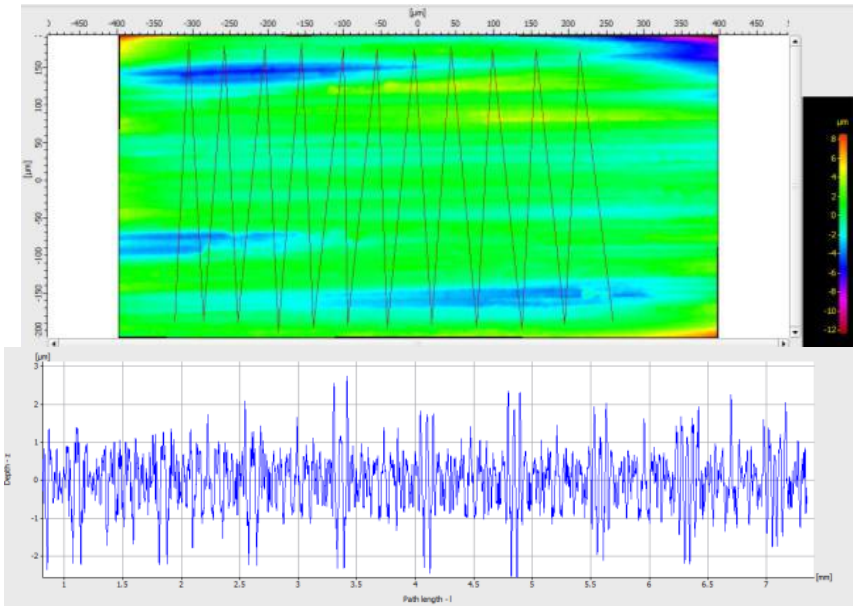
Roughness: Profile VS Area



Roughness-Profile Based

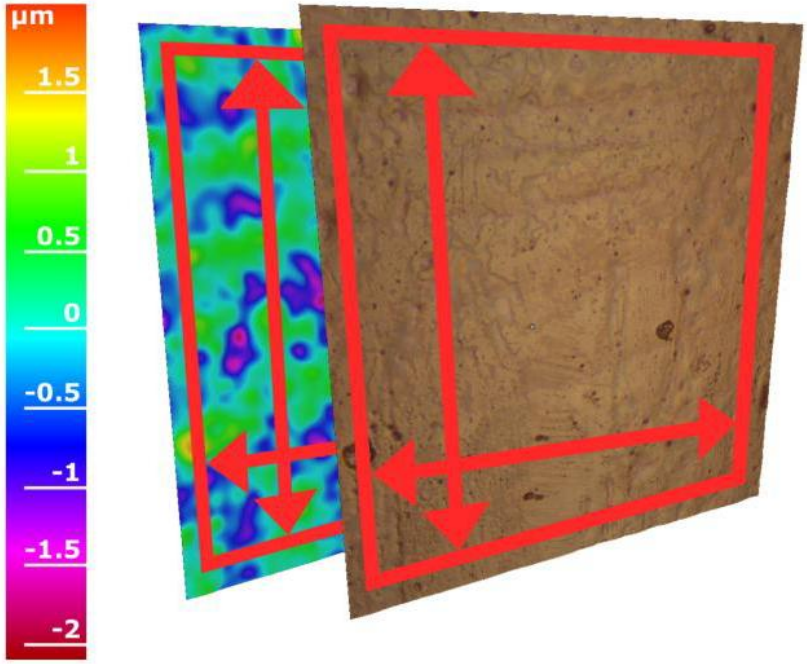




» Ra **86.029** nm

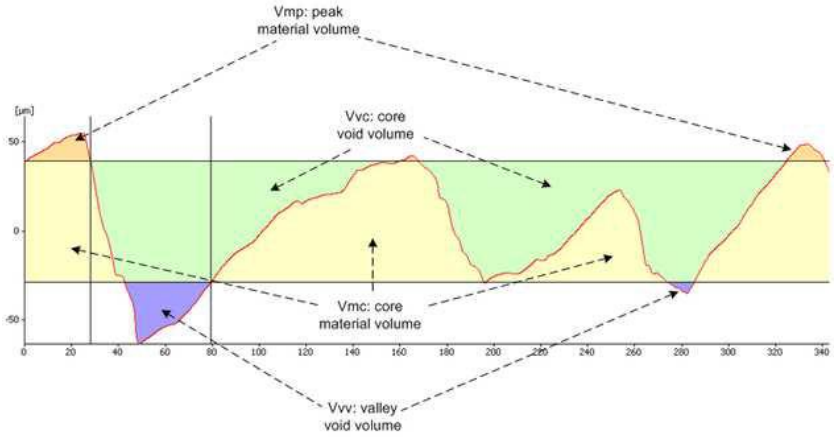
Ra **559.06** nm

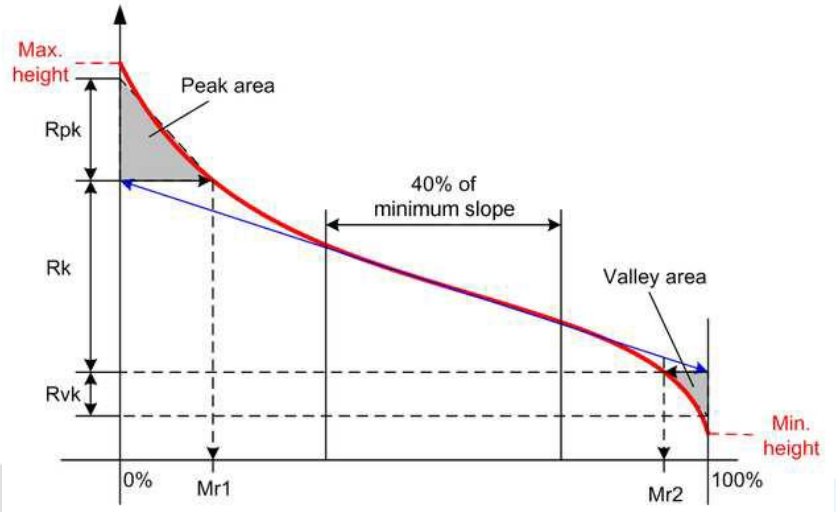
Roughness- Area Based



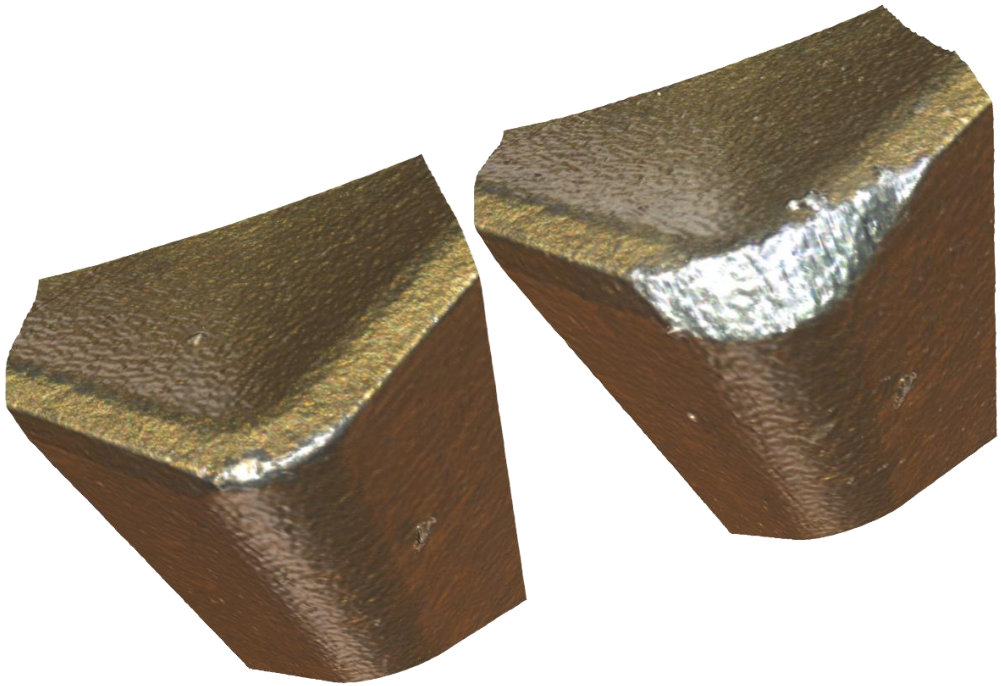
» Sa **582.79** nm

Core Surface Volume

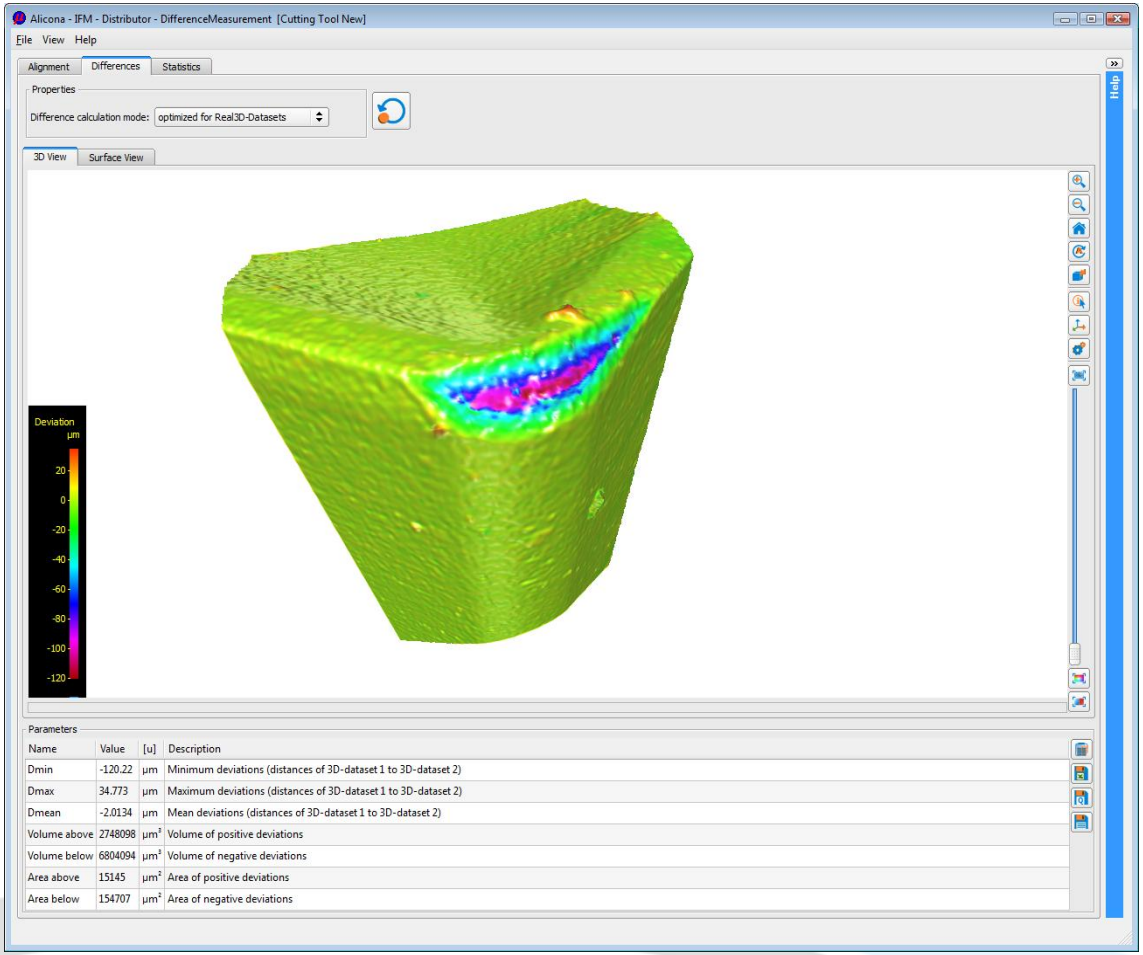




Difference Measurement



Difference Measurement



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Measurements include…

- **Roughness** measurements
  - Profile based

    4287,…
  - Area based

    ISO 28178, corrosion,…
- **Form** measurements

  Diameter, sink hole measurement, roundness…
- **Orientation** measurements

  Distances, geometries,…

Focus-Variation provides…

- Up to **100 Mil. 3D-points**
- Across an area of **100x100mm**
- **Vertical scan range** of **100mm** (at 23mm working distance)
- Full **360°**
- **The largest variety of materials** (solid)
- Resolution of up to **10nm**
- **Data Export: .STL, TEXT, VRML, .SUR, OpenGPS**

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Focus Variation

Form and Roughness in One System

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